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REPORT ON THE UNITED NATIONS REGIONAL CONFERENCE ON SPACE TECHNOLOGY FOR SUSTAINABLE DEVELOPMENT IN AFRICA

(Dakar, Senegal, 25-29 October 1993)

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BACKGROUND

Basic space science

1. One of the space research institutes in Africa that have contributed to recent interplanetary observations is the Helwan Institute of Astronomy and Geophysics at Cairo, which was established in 1903. The main activities of the Institute are in geomagnetism, seismology, astronomy and space research. The Institute shared in the discovery of the planet Pluto in the 1930s and was instrumental in the observation of Halley's comet in 1910, Comet Kohotek in 1974 and Saturn's moon, Titan, in 1980. It was one of the few observatories that participated in the study of aerosol in the atmosphere.

2. In the late 1960s, an Italian group of astronomers established a launching and tracking station at San Marco, in Ungwana Bay, near Malindi, Kenya. The station was used to launch the Uhuru satellite, which contributed to the study of X-ray sources. Botswana, Burkina Faso, Ethiopia, Nigeria, Senegal and the United Republic of Tanzania were all hosts to the tracking facilities for the Gemini, Apollo and Skylab missions of the United States of America. With active contributions from its universities and research institutions, all of which are generously supported by the Government, South Africa has the most vibrant programme in space science and technology in Africa. Indeed, the only remote sensing ground receiving station on African soil today is in Johannesburg. Without much local support, a few other African universities have initiated basic programmes in these fields.

Earth observation

3. In its resolution 280 (XII) in February 1975, the Council of Ministers of the Economic Commission for Africa (ECA) called upon the Executive Secretary of ECA to establish, as a matter of urgency, a remote sensing programme. The outcome of that decision was the establishment of the Regional Centre for Services in Surveying, Mapping and Remote Sensing (RCSSMRS), at Nairobi; Regional Centre for Training in Aerospace Surveys (RECTAS), at Ile-Ife; and Centre régional de télédetection de Ouagadougou (CRTO) at Ouagadougou. In addition, the ECA secretariat is mandated to provide, through its Natural Resources Division, expert advice to its African member states on all aspects of remote sensing. In Africa, countries with appropriate and functioning instruments, such as Automatic Picture Transmission (APT), Weather Facsimile (WEFAX) or High Resolution Picture Transmission (HRPT) stations are able to receive weather information from meteorological satellites owned by European Organization for the Exploitation of Meteorological Satellites (EUMETSAT) and the National Oceanic and Atmospheric Administration (NOAA) of the United States.

Communications

4. In 1977, the General Assembly of the United Nations proclaimed, by its resolution 32/160 of 19 December 1977, the period 1978-1988 as the Transport and Communications Decade in Africa. This Decade was to focus on the rapid development of national networks, so that every citizen, wherever or whomever he or she may be, may have a fair share of the benefits of technological progress, and on providing a powerful impetus to the building of infrastructures necessary for all development. The Pan-African Telecommunications Network (PANAFTEL), which was set up to link communication systems in Africa, was under development at that time and is still operational. The Regional African Satellite Communication System (RASCOM), which was formally established in 1992, is complementing the agenda of PANAFTEL with plans for an eventual dedicated communication satellite for Africa.

Focus of the Conference

5. The Conference focused on the necessary steps, nationally and continent-wide, that would enable Africa to contribute effectively to national, regional and international programmes in communication systems, climate research, ocean observation, land and forest inventory, including the programmes called for by Agenda 21 of United Nations Conference on Environment and Development (UNCED)[1] in order to ensure that Africa and its people derive significant benefits from the ever-expanding frontier known as space science and technology, which is one of the major preoccupations of humanity.

INTRODUCTION

6. The United Nations Regional Conference on Space Technology for Sustainable Development in Africa, which had a theme of "Space systems as tools for meeting Africa's environmental, natural resources, information and management needs", was held at Dakar, Senegal, from 25 to 29 October 1993. The Conference was organized under the auspices of the Space Applications Programme of the Office for Outer Space Affairs of the United Nations with the assistance of the Government of Senegal; it was co-sponsored and co-financed by ECA, Sudano-Sahelian Office of the United Nations Development Programme (UNDP), World Meteorological Organization (WMO), Government of France, European Space Agency (ESA), Earth Observation Satellite (EOSAT) Company, MacDonald Dettwiler, Telespazio and United States Geological Survey.

7. The Conference focused, inter alia, on (a) plans and programmes that could sustain effective national participation in the development and utilization of environmental information systems, with due consideration given to Agenda 21 of UNCED; (b) roles of space technology in the social and economic development of Africa; (c) investment in communications research, development and growth in Africa as well as in privatization and commercialization, with emphasis on production and delivery of services including those needed for rural communications, education, health care and disaster mitigation; (d) mechanisms for the promotion of cooperation between the relevant African institutions and entities; and (e) development of indigenous capability in space technology at the local level.

8. Several plenary, technical and panel discussions were held during the Conference, in which both specialists and policy makers exchanged ideas and opinions, and offered recommendations for future cooperation in those fields. The last two days of the Conference were devoted to intensive discussions at the working group level, and culminated in the formulation of observations and recommendations presented herein.

9. Other elements of the Conference included: (a) a panel discussion on space science and technology in Africa with emphasis on the role Africa and its people should play in the understanding, development and utilization of space technology for their own social and economic development; (b) a poster session that demonstrated the results of projects undertaken in Africa on remote sensing and geographical information systems as well as those on satellite meteorology; and (c) a youth forum that was attended by over 300 students from Senegalese schools. The goal of the youth forum was to enhance the interest and understanding of the youth of Africa in space science and technology and its various applications, and in the atmosphere.

10. Participating in the Conference were representatives of the Governments of Canada, France, Spain and the United States of America, UNDP, United States Geological Survey, WMO, the World Bank and the United Nations Office for Outer Space Affairs, AFRO-VISION, Food and Agriculture Organization of the United Nations (FAO), National Centre for Space Studies of France (CNES), COMSAT, EOSAT, ESA, EUMETSAT, International Maritime Satellite Organization (INMARSAT), MacDonald Dettwiler, National Aeronautics and Space Administration (NASA), RCSSMRS, RECTAS. Among those participants were policy makers and senior technical advisers including ministers, ambassadors, a university president, an astronaut, senior university educators, directors, planners, programme managers, and research and application scientists

from 47 African governmental and non-governmental entities with programmes relevant to the theme of the Conference. A total of 133 participants attended the Conference.

I. RECOMMENDATIONS

A. Decision makers and the importance of environmental data acquisition, processing and utilization

11. Because most national policies have environmental implications, each African Government should develop and implement programmes that will provide the general public as well as policy makers and decision makers with a fundamental knowledge and understanding of the relationship between the atmosphere, human survival and the ecological systems that provide the food and fibre that sustain life. The aforementioned programmes should provide appropriate orientation on the value of environmental information (e.g. Earth resources and meteorological data) for economic development. Such programmes should emphasize the urgent need to develop and maintain accurate and systematic environmental data collection, analysis and applications procedures, including the up-keep of the facilities for such services. Each African Government, working in cooperation with its universities and its news media (print and electronic) can effectively develop and implement such programmes. On request, the United Nations, through its various channels, including the Office for Outer Space Affairs (Space Applications Programme), can offer assistance.

12. Eastern, central and western Africa are the only three major subregions of the world that are not covered by any ground station that is capable of receiving data from Earth observation satellites, such as LANDSAT, ERS-1 and SPOT. In the absence of on-board recording systems on current and future generations of Earth observation satellites, essential historical data, which will be needed for future economic development programmes of the countries in these subregions, are being irretrievably lost. Accordingly, through existing subregional groupings (e.g. Economic Organization of West African States (ECOWAS)), African countries and related funding institutions (e.g. African Development Bank) should invest in the development of necessary infrastructure for the acquisition and processing of satellite data on the natural resources and environment of these subregions. A similar arrangement is in progress in the ongoing regionalization of the Cotopaxi (Ecuador) ground-receiving station for the benefit of countries in the Latin American and Caribbean regions. As a group, African Governments should also seek the assistance of the World Bank for data acquisition support through the Global Environmental Facility (GEF).

B. Long-term commitments and investments

Capacity building at the local level

13. African Governments should make an adequate and long-term commitment to, and investment in, the development of skills and knowledge as well as needed infrastructure in Earth observation and related disciplines at the local level. Such commitment and investment will enable African countries to share in the benefits inherent in Earth observation and environmental information programmes, through indigenous understanding and utilization of this technology to solve local problems and through the subsequent participation of African countries in regional and international programmes and projects (e.g. Global Climate Observing System (GCOS), Global Ocean Observing System (GOOS), and Global Terrestrial Observing System (GTOS)).

14. African Governments should realize that there is an urgent need for scientific and technological capacity building at the local level in order that Africa can contribute to the action programmes that all countries in the world, including those from Africa, clearly mapped out in Agenda 21 of UNCED. Agenda 21 called for a global effort to better understand the Earth in order to appreciate the effects of human action on Earth

system processes, monitor the changes that occur with time and search for more environmentally sustainable ways of using and managing the Earth's resources.

Role of universities and technical institutions

15. Different aspects of space science and technology, including its fundamentals, development and related applications should become an integral part of appropriate curricula at African universities and technical institutions. These should be initiated and enhanced with a view to encouraging African scientists to actively participate in and contribute to the understanding, evolution, growth and application of this technology in national and regional social and economic development programmes. On request, the United Nations, through its Space Applications Programme, can assist in developing the necessary curricula in remote sensing, satellite meteorology, satellite communications and basic space science as may be appropriate in each case. This recommendation should be transmitted to all African universities and research centres through the Association of African Universities.

16. Children may constitute 25-30 per cent of a country's population, but they represent 100 per cent of a country's future. A substantial investment in pre-college education may severely strain short-term education budgets, but the consequences of not investing may be to test the survivability of a country in an increasingly technological world. Thus, African Governments should review their pre-college education strategies, policies and budgets with a view to infusing aerospace science and technology into the educational process at the elementary and secondary school levels.

Support for United Nations initiatives

17. In order to promote the development of skill and knowledge in remote sensing, satellite meteorology, satellite communications and basic space sciences, all African countries should support the initiative and ongoing effort of the United Nations to establish Regional Centres for Space Science and Technology Education in Africa.

C. Inventory of data

18. Planning and execution of projects in most African countries depend on disparate sources for essential information. Thus, there is a need for the establishment of a national multidisciplinary natural resources coordinating centre in each country. Such a data focal point should:

(a) Inventory and catalogue all existing relevant environmental and natural resource data (biophysical and socioeconomic) in the country;

(b) Inventory and catalogue research activities, and the researchers, with a view to promoting collaboration and reducing duplication;

(c) Coordinate the status of data of different national agencies;

(d) Acquire up-to-date information on all maps and environmental and other natural resource data being acquired in any part of the country, and ensure that information on where such data can be found is made available by those responsible for generating them to the coordinating centre and is published in a publicly available and regularly updated electronic or hard-copy directory;

(e) Provide regular professional advice to government on national resource information that may be essential to the implementation of national programmes;

(f) Cooperate with subregional and international bodies to define standards for data collection, archiving and exchange.

D. Communications development and utilization in Africa

19. African countries (Governments as well as the private sector) should directly invest and engage in long-term science and technology research and development efforts with a view to developing and producing basic communications equipment in Africa. In this connection, African countries (one or two countries should take the initiative and play the leading role) should cooperate with one another and with other countries outside the continent, particularly the emerging space-faring countries of Brazil, China, India and the Republic of Korea.

20. Space communications technology should be integrated into the appropriate curricula of African universities and technical institutions with a view to encouraging African scientists to participate in and contribute to communication development and growth in their own countries, as well as at the regional and international level.

21. African Governments must adjust quickly to the new global and digital communications era by liberalizing the operational climate of telecommunications in their own countries and by focusing on regulating the communications sector.

22. African Governments should strive to privatize and commercialize satellite communications services in Africa in order to engender competition, reduce costs and achieve higher levels of efficiency. Such processes should take full account of the needs peculiar to each country while at the same time ensuring that the mission of providing universal communications to the rural areas is fully met.

23. In Africa, over 72 per cent of the inhabitants live in rural areas with often rugged or inhospitable terrain and limited facilities for transportation and communication. Accordingly, African Governments and industrialists should urgently engage in the development and manufacture of telecommunications systems which can operate inexpensively and can function in rural and unelectrified areas, using a minimum of energy, and which can be integrated with a maximum number of terrestrial systems. Special emphasis should be placed on simplified maintenance and operation costs.

24. African Governments should make special efforts to effectively utilize space communications technology, particularly in the delivery of health services and education, as well as in the reduction of disaster-response time.

25. African Governments should actively participate and play a greater role in the standards development process of the International Telecommunication Union (ITU) and INTELSAT in order to ensure that the particular needs of Africa are taken into account.

E. Interaction among regional and subregional institutions

26. Governing councils or boards of appropriate regional and subregional institutions should ensure that these institutions are strengthened to coordinate activities on a regional level.

27. With the support of African Governments, these regional institutions should participate fully in the standardization of data collection, data-processing methodologies, and data archiving and exchange between different countries within their regions and subregions in Africa.

28. African Governments and the governing councils or boards of existing regional and subregional institutions should ensure that these institutions are linked with each other and with national centres in order that they can all be fully aware of activities in the different parts of Africa and can support one another and avoid duplication of activities.

29. Governing councils or boards of existing regional institutions should also participate in defining common regional interests in order to strengthen cooperation at intercountry and interregional levels.

F. Continental linkages

30. In order to contribute to the acceleration of unity and development in Africa, there is an urgent need to establish an efficient communication network/linkage among African professionals and scientists at national and subregional levels. Such an infrastructure will facilitate the exchange of ideas, data and experiences on various space-related activities, including education, research, applications and services. The necessary linkages may be achieved through inexpensive tools such as electronic mail facilities. The private sector should act on this initiative.

31. There is a need to establish, through the Association of African Universities and national academies of sciences or science research councils, an African scientific journal dedicated to the publication of scientific works and Africa-wide merit awards to stimulate the interest of scientists in space science and technology.

32. African Governments, through their national research or scientific councils or academy of sciences, should financially support the formation of national and Africa-wide professional scientific organizations.

G. Import duties versus development and growth

33. African Governments often impose heavy import duties or excise taxes on imported data, hardware, software and associated accessories, particularly those destined for environmental, natural resources and communications development programmes. Such practices inhibit investment and stifle the development and growth of both the public and private sectors in these fields. African Governments should remove import duties particularly on those items designed for research, education and public services. Such a step would stimulate growth in public and private activities designed to promote science and technology developments in Africa.

H. Follow-up

34. The participants agreed that the Conference should be reconvened in 1995 in order to gauge the status of the implementation of its recommendations, the progress of which the United Nations, through its Office for Outer Space Affairs, agreed to monitor. Each participant agreed to be the conscience of his/her country in the implementation of the recommendations contained herein.

II. OBSERVATIONS

A. Environmental and natural resources data

Value of data

35. An array of Earth observation satellites for meteorological and marine observations, as well as for Earth resources surveys, owned by a few countries, provides copious environmental and natural resources information for the international community. Such information is finding wide application, particularly in the

management of water resources; forest and crop inventories; geological and mineral exploration; environmental management including weather forecasting and its impact on agro-meteorology; cartography and mapping and their subsequent use in the development of roads, pipelines, power lines and related engineering applications, land use and urban development; oil-pollution survey and monitoring; assessment and management of coastal/marine environment; shipping and ocean resources; civil and military aviation; tourism; disaster assessment and mitigation; search and rescue missions; monitoring of drug-related plants; and the assessment of the impact on the environment of human activities. That process is being intensified on a daily basis. And for a long time to come, space-borne sensors may be the main source of reliable data on the environment and natural resources of many African countries.

36. Such information as given above can be used to provide the basis for decision-making as well as the means for monitoring the outcome of past decisions. It can also be used to enhance opportunities for planned development and can provide opportunities for a country to tailor its development activities in a manner compatible with its resource base. Such information can also provide a country with the opportunity of entering into mature mutually beneficial resource exploitation relationships with other countries. Because observation of the Earth from space can be used to undertake crop forecasting, it provides opportunities for economic bargaining and the planning of appropriate measures that could be employed in a period of surplus or scarcity.

Data availability and usage: current status

37. Data is needed for overall national and district-level planning, for project implementation, for harnessing a given resource and for monitoring and assessing the environmental impact of a given development programme. However, gaining access to biophysical data, particularly space-acquired data of the Earth and its environment has been difficult for many African countries. Environmental and natural resources data of West, Central and East Africa remain unrecorded because these areas are not within the coverage zone of any ground-receiving station and most of the operating Earth observation satellites do not currently carry on-board recording facilities. For many of the African countries, their base-line data is either out of date or non-existent. In cases where data is available, there is a lack of awareness of what is available, its relative value and usefulness. There is also very little communication between those who have the data (e.g. meteorological, natural resources and environmental), and those who need it for decision-making. For the decision maker, inadequate or inaccurate information can lead to catastrophic decisions and untold hardships for those affected by such decisions. With or without data, development schemes are being conceived, planned and executed in many parts of Africa. The unknown element is the future of such projects.

38. Africa has a large number of environmental information systems that are based on both conventional and space-related techniques. However, these systems are as diverse as the countries themselves and there is no proper coordination. The information collected through such systems is not easily shared between different users. The collection and use of data on the continent is spotty and is shrouded in fears of insecurity and excessive bureaucracy. Indeed, a large percentage of meteorological stations remain non-functional either because of the lack of essential equipment and personnel or because the equipment in place has fallen into disrepair.

Current status of indigenous capability and its usage

39. Although there have been a few notable successes, the pace of the development and utilization of an environmental information system (remote sensing and satellite meteorology) in Africa lags far behind similar efforts in other regions of the world. One reason is that the majority of environmental information systems and other technology-related projects in most of the African countries continue to depend on foreign experts for their conceptual development and implementation. However, once the foreign experts are withdrawn, such projects often falter. One of the major reasons for such failures is that the country counterparts, who are

mostly technicians, are generally not well-versed in the fundamentals of the principles and concepts being applied. In addition, in many cases, local experts, particularly those within the academic communities, are often ignored and excluded from participating in such projects. Indeed, a very significant number of ongoing remote sensing projects in Africa are supply-driven, application-oriented and dependent on external assistance.

Earth observation programmes affecting Africa

40. The Conference noted the various Earth observation systems/programmes that are either in operation or being developed in different parts of the world, especially those that could have direct impact on Africa's social and economic development. These include:

(a) The ERS system of the European Space Agency with its all-weather observing capability and the planned ENVISAT and METOP satellites of that organisation;

(b) The plan of TELEOS (Telespazio and EOSAT) to establish a natural resource monitoring programme for East Africa through the installation of a portable ground receiving station capable of receiving data from ERS, SPOT, LANDSAT and TEMISAT* satellites;

(c) The use of SPOT satellite data, particularly within the Sahara and Sahel Observatory (SSO) and other programmes, to address various environmental issues, including desertification and other disasters, forest resources and food security in Africa;

(d) The LANDSAT system of the United States and the use of data from that system to undertake projects on tropical deforestation particularly through the LANDSAT Pathfinder Project;

(e) The Global Change Project of NOAA in Africa; standardization of the use of NOAA data in each national and regional centre (units in Addis Ababa, Cairo, Dakar, Harare, Nairobi, Niamey) within the SSO programme;

(f) The programmes of USGS for environmental information systems in Africa;

(g) The GlobeSAR campaign of Canada, which was preparing participants, including Africans, to use airborne radar and RADARSAT data for specific applications in the future;

(h) The Global Change Encyclopaedia (GEOSCOPE) of Canada, an atlas of the Earth featuring integrated diverse national data sets;

(i) The efforts of MacDonald Dettwiler of Canada on information technology in Africa;

(j) The weather and agro-meteorological programmes of EUMETSAT which, with the aid of its METEOSAT satellites, provide continuous information to meteorological stations throughout Africa; optimization of METEOSAT data for rainfall estimation within the SSO programme;

(k) The Maspalomas Station of INTA in Spain and the various services it provides for northwest Africa, including opportunities for cooperation with countries in this subregion.

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*TEMISAT is a micro-satellite system that is being developed by Telespazio for the collection of environmental data over wide areas that are usually difficult to reach or that lack communications infrastructure.

B. Space communications (telecommunications) services in Africa

Value of a functional telecommunications system

41. Space technology is central to global commerce and development, to peacekeeping and disaster mitigation, to science, to the exploration of the Universe and to industrial development. An indispensable element of human global activity is access to communications services. The mix of terrestrial telecommunications networks and satellite communications systems meets many of the modern demands for communication. In many developing countries, where terrestrial systems are underdeveloped or even non-existent, satellite communications services, which have witnessed rapid advances in the previous three decades, are of particular importance. Telecommunications services are also invaluable for the delivery of health services, disaster mitigation, and air and marine navigation.

42. Satellites are expected to be a key element of future mobile communication systems. Commercial mobile satellite service started from a maritime satellite communication base and has gradually expanded to include land mobile and aeronautical communications. Currently, suitcase-size portable terminals can provide satellite communications where terrestrial facilities are not available.

Current communications technology in Africa

43. Studies conducted by ITU and the World Bank have clearly demonstrated the benefits of telecommunications both as an input and a catalyst to development. Nevertheless, the African telecommunications network is one of the least developed in the world. In 1988, the continent had a total of 4.3 million direct exchange lines and a telephone density of 0.75 per 100 inhabitants compared with a density of 4.1 per 100 for Latin America. Only 1.1 per cent of the world's telephone lines are located in Africa and more than half of these lines are in South Africa. According to an assessment by the Telecommunications Research Centre (TRC), based in the United Kingdom of Great Britain and Northern Ireland, the situation is only likely to change slowly before the year 2000. TRC predicts an annual growth rate of only 4.6 per cent with the number of lines rising to 8.1 million by the year 2000. Total spending in Africa on new telecommunications infrastructure was US$ 2.3 billion in 1990, which TRC forecast will grow to US$ 2.6 billion in 1995 and US$ 3.6 billion by the year 2000. Nevertheless, that figure will represent only 2 per cent of global telecommunications spending, compared to 47.7 per cent in Europe. In addition, in comparison with similar services around the world, telecommunications services in Africa are the most expensive and the least reliable.

44. Overall, State-owned Post, Telegraph and Telephone (PT&T) establishments retain the monopoly as telecommunications operating entities in Africa. That model is the leftover of a bygone era, when analogue telecommunications infrastructure was expensive and could only be afforded by the budget of State-supported enterprises or by multinational corporations. Currently, however, digital technologies are reducing considerably the investment cost of building and running telecommunications networks. The digital revolution is rapidly shaking up the communication and information industries. It makes cost-effective technologies readily available and affordable.

Programmes and systems in place or under development

45. Fully and partially dedicated communications systems and projects that are particularly relevant to sustainable development in Africa include those of INTELSAT, INMARSAT, ARGOS and METEOSAT as well as the planned RASCOM and AFRISPACE projects.

46. Several African countries are currently undertaking a number of programmes to develop their economies. An adequate telecommunication infrastructure is crucial to the success of such programmes. Accomplishing the latter will require continent-wide collaborative efforts that encompass workforce and financial resources, particularly for the planning, design, construction and management of such projects. Two

such major programmes, PANAFTEL and RASCOM, the goal of which are the development of a pan-African telecommunication network, are currently being conducted.

47. The main objective of the PANAFTEL network is to enable African countries to communicate directly with one another without transmitting through switching centres that are located outside of Africa. This project, which is supported by a large number of regional, subregional and international organizations, as well as by multilateral and bilateral financing institutions, calls for the integration of existing radio-relay systems and the establishment or installation of new radio-relay systems, telephone switching centres, sub-marine cables and satellite Earth stations. A significant portion of the task has already been accomplished. RASCOM was formally established by 43 African countries in 1992 under the auspices of ITU. The latter has just completed a detailed analysis of the telecommunications system in Africa. With Abidjan as its base, RASCOM will start its operation by pooling various satellite transponders being used by African countries. It will subsequently proceed to the long-term objective of establishing a dedicated satellite for the continent.

48. In addition to its standard services, INTELSAT currently offers the Intelnet service which can be used for domestic networks consisting of one or more large hub stations and a large number of small, low-capacity terminals. As an aid to developing countries, INTELSAT has also established the Intelsat Assistance and Development Programme (IADP) and the Intelsat Development Fund (IDF). INMARSAT operates a system of satellites providing telephone, telex, fax and data services for ships at sea, aircraft, land mobile users and remote land users. A new development in the 1990s will be the establishment of worldwide mobile satellite systems. The focus of the planned Project 21 of INMARSAT is the extension of its mobile service to hand-held voice communication systems. The proposed mobile systems offer a worldwide coverage that would include rural areas in Africa.

49. Satellites also provide international links for the exchange of programmes between studios. Several African countries are linked to international news exchange networks such as CNN and Worldnet. The Afro-Vision network provides satellite capacity for news exchange between African broadcasters. The Union of African Radio and Television Broadcasters (URTNA) provides a pan-African platform for national broadcasters to establish and further develop such exchange networks. In addition URTNA organizes training courses for radio and television broadcasting personnel.

C. Focus on African youth

50. If an indigenous scientific and technologically literate workforce is to exist in sufficient numbers to be capable of both sustaining space science and development and nurturing future growth in Africa, early education is a prerequisite. Prominent educators have established that children learn the importance of reading, writing and mathematics in elementary schools, and that career and vocational choices, while often vague, are being formulated at the middle-school level. These are brought into focus in high school and subsequently refined in universities.

51. Each adult can recall those times, most probably in the early teens in middle school, when the thought of post-school careers focused on a number of options: police officer, veterinarian, scientist, secretary, teacher or engineer. Motivating student interest in careers in science and technology in those early, formative years is the best assurance that African countries have for securing the level, quality and quantity of engineering and technical competence needed for long-range, sustainable development.

Note

[1] Report of the United Nations Conference on Environment and Development, Rio de Janeiro, 3-14 June 1992 (A/CONF.151/26/Rev.1 (Vol. I and Vol. I/Corr.1, Vol. II, Vol. III and Vol. III/Corr.1) (United Nations publication, Sales No. E.93.I.8 and corrigenda), vol. I: Resolutions adopted by the Conference, resolution 1, annex. II.

Annex

PROGRAMME OF THE CONFERENCE

Date	Time	Subject	Speaker
Sunday 24 October		Arrival and registration	
Monday 25 October		Plenary session A: Opening session and keynote addresses	
		Chairman: A. A. Abiodun	
	0900-0945	Inauguration and opening ceremony	
		United Nations welcome address	A. A. Abiodun
		UNDP welcome address	B. Diaby-Ouattara
		Government of Senegal opening address	Hon. Abdulai Basily (Minister of Environment)
	0945-1115	Keynote addresses	
		Remote sensing applications in Senegal	A. Sow (Senegal)
		The case for space science in Africa	D. A. Bekoe (Ghana)
		Plenary session B: Africa and space exploration	
		Chairman: I. E. Ayewah (Ambassador of Nigeria to the United Nations, New York)	
	1130-1205	The role of satellite communications in economic development	I. Knight (COMSAT)
	1205-1240	Space technology: A tool for sustainable development	F. Roscian (ESA/ESRIN)
		Plenary session C: Addressing sustainable development in Africa	
		Chairman: V. Odenyo (FAO, Zimbabwe)	
	1400-1440	Africa's accessibility to data of its natural resources and environment: Problems and possible solutions	K. Ferguson (EOSAT, USA)

Date	Time	Subject	Speaker
	1530-1610	Initiatives for monitoring Africa's environment and natural resources management needs	N. Snape (MacDonald Dettwiler)
	1610-1650	The Sahara and Sahel Observatory: Status and future direction	A. Faizoun (France)
	1650-1730	Development of indigenous capability in space technology	A. A. Abiodun (United Nations)
Tuesday 26 October	0900-0945	Plenary session D: Theme presentation	
		Chairman: I. Knight (COMSAT)	
		Topic: The RASCOM project including the improvement of international services among African countries: Objectives, status and future prospects	R. Maga (Cameroon)
	1000-1230	Technical session I	
		1. Space communications (telecommunications services)	
		Chairman: R. Maga (Cameroon)	
	1000-1040	Mobile communications services in Africa: Pros and cons	J. Asinugo (INMARSAT)
	1040-1120	Telemedicine in Africa	M. Jemison (USA)
	1120-1230	Is Africa being well served by existing communications services?	R. Maga (Cameroon) and N. Samara (World Space, USA)
		2. Environment information systems	
		Chairman: Luka Isavwa, Director of Remote Sensing Division (RCSSMRS, Nairobi)	
	1000-1040	Status of environmental information systems in Africa	H. Hassan (World Bank)
	1040-1120	ESA Earth Observation Programmes (ERS systems, ENVIROSAT etc.)	F. Roscian (ESA)
	1130-1210	GEOSCOPE: An inter-active Global Change Encyclopaedia	M. Beaudoin (CCRS, Canada)
	1210-1250	Remote sensing research in semi-arid regions	E. Njoku (NASA)

Date	Time	Subject	Speaker
		3. Satellite meteorology	
		Chairman: E. E. Balogun (Nigeria)	
	1000-1040	Meteorological applications in Africa: status, problems, possible solutions	E. Mukolwe (Kenya)
	1040-1120	EUMETSAT Services Supporting Sustainable Development	J. Lafeuille (EUMETSAT)
	1120-1200	PHOTONS: A network of automatic sun radiometres in Africa for monitoring aerosol climatology and atmospheric corrections in satellite imagery	D. Tanre (France)
	1200-1240	Direct read out of meteorological satellite data	R. Popham (USA)
	1400-1445	Plenary session E: Theme presentation	
		Chairman: A. Fanta (RCSSMRS)	
		Topic: Development and implementation of a monitoring programme for environmental information systems	D. G. Moore (USA)
		1. Remote sensing and geographical information systems	
		Chairman: P. O. Adeniyi (Nigeria)	
	1530-1600	Landsat Pathfinder Tropical Deforestation Programme	W. Lawrence (USA)
	1600-1630	Global Change Project for Africa	E. Njoku (NASA)
	1640-1710	Remote sensing and GIS for food security	V. Odenyo (FAO, Zimbabwe)
	1710-1740	Integration of spatial data into decision-making process in Senegal	A. Camara (Senegal)
		2. Education	
		Chairman: G. Johnson (Sierra Leone)	
	1530-1610	Space Technology and Hydrology Education	R. Popham (USA)
	1610-1640	ISPRS and the Land Remote Sensing Policy Act of 1992: International Research Education Opportunities in PL-102-555	S. A. Morain (ISPRS)

Date	Time	Subject	Speaker
	1640-1710	Development of GDTA training in remote sensing and geographic information system: Activities in Africa	G. Weill (France)
	1710-1740	Science and technology in Africa's future	J. Brito (UNDP)
	1900-2100	Plenary session F: Panel discussion	
		Space science and technology in Africa	
		Chairman: D. A. Bekoe (Ghana)	
		Introductory remarks	
		An overview of space science and technology in Africa	F. Onyango (Kenya)
Wednesday 27 October	0900-0945	Plenary session G: Theme presentation	
		Chairman: A. A. Abiodun (United Nations)	
		The AfriSpace Satellite Radio Broadcasting Services for Africa and the Middle East	N. Samara (Worldspace, USA)
	1000-1230	Technical session II	
		Chairman: R. Maga (Cameroon)	
		1. Space communication (broadcasting systems and cooperation programmes in Africa)	
	1000-1030	COSPAS-SARSAT's SPMCC in Maspalomas: A search and rescue security umbrella over northwest Africa	J. Melián (Spain)
	1030-1100	Regional Direct Satellite Broadcasting Service in Africa: Prospects and problems	H. Chasia and H. Toure (INTELSAT)
	1100-1130	A day in the life of AFRO-VISION	L. Leysen (AFRO-VISION)
	1140-1210	Maspalomas Station and northwest Africa: Opportunities for cooperation	J. Melián (INTA, Spain)
	1210-1240	INTELSAT communication assistance programmes: Objectives/limitations	H. Chasia and H. Toure (INTELSAT)

Date	Time	Subject	Speaker
		2. Data transmission and applications	
		Chairman: R. A. Boroffice (Nigeria)	
	1000-1030	GlobeSAR Campaign in Africa	M. Beaudoin (CCRS, Canada)
	1030-1100	Land cover spacemap and geographic database of Africa	R. Michel (FAO)
	1100-1130	Space application potentials in the coastal marine environment of the Atlantic Coast of Africa: Case study of the coastal zone in Senegal	E. Diop (COMARAF, Senegal) A. A. Abiodun (United Nations) J. Citeau, H. Demarq (UTIS-ORSTOM/ISRA)
	1140-1210	Focus on Africa for a world hydrological cycle system	S. Pieyns (WMO)
	1210-1240	Operational remote sensing application to address national resource management needs	G. Appone (Telespazio)
	1400-1510	Plenary session H: Theme presentations	
		Chairman: T. Woldai (Ethiopia)	
	1400-1430	Maspalomas Station and northwest Africa: Opportunities for cooperation	J. Melián (Centro Espacial Canarias)
	1430-1510	Le changement climatique global et l'Afrique subtropicale: questions scientifiques et réseau medias	J. P. Ceron (Meteo-France UMT)
		Topic: The African scientist and remote sensing of the environment	P. Adeniyi (Nigeria)
	1520-1530	Poster session	
		(Results of projects undertaken in Africa on remote sensing and geographical information systems, satellite meteorology, communications and space science)	

Date	Time	Subject	Speaker
	1930-2000	Plenary session I: Youth forum	
		Chairman: F. N. Onyango (Kenya)	Panelists
		Topic: Fostering scientific thinking process in African youth through exposure to space science and technology	D. A. Bekoe (Ghana) E. E. Balogun (Nigeria) A. Ayamba (Kenya) M. Fofana (Côte d'Ivoire) R. Kane (Senegal)
Thursday 28 October	0900-0945	Plenary session J: Theme presentations	
		Chairman: A. A. Abiodun (United Nations)	
		Topic: Commercialization of communication services in Africa: Opportunities, advantages and bottlenecks	R. Maga (Cameroon)
	1000-1230	Working group	
		Topic: Environmental information needs in Africa	
		Chairman: E. Mukolwe (Kenya)	
		Rapporteurs: Alex Faizoun (France) Ademola Omojola (Nigeria)	
		Topic: Communications for development in Africa	
		Chairman: Richard Maga (Cameroon)	
		Rapporteurs: Godfrey Johnson (Sierra Leone) I. Chetima Tidjani (Niger)	
	1400-1700	Technical visit to OSTROM facilities in Dakar	
Friday 29 October	0900-1230	Continuation of the Working Group	
	1400-1730	Plenary session K: Analysis of recommendations	
		Chairman: A. A. Abiodun (United Nations)	
		Rapporteur: R. K. Sebatindira (Uganda)	
		Presentation of recommendations and observations by the chairmen of the Working Groups	

Date	Time	Subject	Speaker
		E. Mukolwe (Working Group I)	
		R. Maga (Working Group II)	
		Discussion by Conference participants	
		Closing ceremony	A. Camara (Senegal) Issa Beye (UNDP) A. A. Abiodun (United Nations)